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RESOURCE PROTECTION UNIT, FOREST INSECT AND DISEASE MANAGEMENT GROUP

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AN EVALUATION OF SEED AND CONE INSECT DAMAGE AT THE ERAMBERT, OUACHITA, AND STUART ORCHARDS IN MISSISSIPPI, ARKANSAS, AND LOUISIANA DURING 1975

by

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ABSTRACT

Production of superior seed from seed orchards in the southern United States is becoming increasingly important and insect-caused seed losses are markedly decreasing production. An evaluation of seed orchard insects causing damage to shoots, conelets, and cones and seed was made during 1975 at the Ouachita, and Stuart Federal Orchards in Arkansas and Louisiana, respectively. Only cone and seed damage was evaluated at the Erambert Orchard in Mississippi. Losses varied according to individual orchards and geographical sources, being most severe at the Ouachita, the next most at the Stuart, and least at the Erambert Orchard. Substantial insect damage is expected next season; therefore, control should continue.

INTRODUCTION

The production of superior seed from pine seed orchards is becoming increasingly important in the southern United States because trees from this seed exhibit increased volume growth, improved form and fiber characteristics, and reduced disease incidence; therefore, are being heavily relied upon to meet future timber production goals. Federal seed orchards are just coming into production and are being depended upon to regenerate national forest land with superior growing stock.

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Insects are the chief agent causing losses (Overgaard 1974) and, if not controlled, will adversely affect the availability of superior pine seed, thereby reducing future timber production. Currently, there is no available evaluational technique using biological data for deciding for or against control or for predicting future population trends of seed orchard insects. Therefore, suppression of these insects is presently based on regular preventative spray schedules rather than on selective pesticide applications using such techniques.

Consequently, the evaluation only shows the seriousness of current cone and seed insect losses at the Erambert, Ouachita, and Stuart Orchards using data obtained from insect monitoring and impact studies conducted by the Forest Insect and Disease Management Group during 1974 and 1975 and does not attempt to predict future losses.

Major insect species considered in this evaluation are coneworms, *Dioryctria* spp., seedworms, *Laspeyresia* spp., seedbugs, *Leptoglossus corculus* L. and *Tetyra bipunctata* Say, and Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock).

METHODS

Conelet loss was determined by tagging and labelling 10 percent, or a minimum of 10 conelet clusters, on each sample ramet and making monthly observations of individual conelets throughout the growing season so as to determine the time and cause of losses. Two ramets of each of five clones in each of three treatments (Cygon®, Di-Syston®, and Check) were tagged as above on shortleaf pines, *Pinus echinata* Mill, at the Ouachita Orchard. Two ramets of each of four clones on loblolly, *P. taeda* L., slash, *P. elliottii* Engelm var. *elliottii* and longleaf pines, *P. palustris* Mill, and one ramet on each of six clones on shortleaf pines were tagged at the Stuart Orchard. None were tagged at the Erambert Orchard.

Impact data from a study conducted on shortleaf pine at the Ouachita Orchard was also used as part of this evaluation. During this study, 100 percent of the clusters were tagged on three ramets of each of nine clones and followed as above from flower formation in February 1974 to cone harvest in October 1975. On the Ouachita shortleaf impact study, all surviving cones were collected and the seed from these extracted and x-rayed as above and then germinated.

Where second year cone losses were assessed, 100 percent of the cones, including damaged cones from each sample ramet, were harvested and counted. From this information, percent coneworm damage was determined. The following were sampled for second year cone damage: two ramets

of each of four clones on each of the Alabama loblolly, Mississippi loblolly, Alabama slash, Florida slash, and Mississippi longleaf geographical sources at the Erambert Orchard and the shortleaf ramets tagged for conelet damage at both the Ouachita and Stuart Orchards.

Five apparently sound cones were selected from each of the above sample ramets except on slash pines at the Erambert Orchard. The cones were dried using warm air and then the seed extracted from them by two methods: first, by shaking individual cones by hand, and then by dissection. Seeds extracted by each method were x-rayed separately; however, for this report, x-ray data for both methods were combined. X-rays were interpreted for sound seed, empty seed, seed bug-damaged seed, and malformed seed.

Seed x-ray data from a cone and seed analysis report by the Eastern Tree Seed Center was also used as a part of this evaluation. Data was based on collection of five cones from each of five ramets of each of three clones (75 cones) from the Texas-loblolly source and five cones from each of five ramets of each of five clones (125 cones) from the Louisiana loblolly source at the Stuart Orchard.

Nantucket pine tip moth shoot damage was evaluated on the same ramets sampled for conelet damage on shortleaf and loblolly pines at the Stuart and shortleaf at the Ouachita Orchards. The 20 topmost tips of each sample tree were examined for damage in September at the Stuart Orchard and August and October at the Ouachita Orchard.

RESULTS

Erambert Orchard

Coneworm, seedworm, and seedbug damage to loblolly, slash, and longleaf second year cones or seed was relatively light at the Erambert Orchard during 1975 (Table 1). Highest damage occurred on Mississippi longleaf with 9 percent of the cones damaged by coneworms, and 5 percent by seedworms. Percent full seed was considered relatively high for all seed sources examined. Seedbug-damaged seed never exceeded 2 percent.

Ouachita Orchard

The Nantucket pine tip moth caused a greater conelet loss than any other insect at the Ouachita orchard during the 1974-75 season, with 45.2 percent of the total flowers lost. Most of this loss occurred during April 1974. The next most serious identifiable agent causing losses was coneworms with 5 percent loss caused by

Table 1. Cone and seed losses on loblolly, slash, and longleaf pines at the Erambert Seed Orchard, Mississippi, 1975.

Geographical Seed Source[2]	Percent[1]					
	%Coneworm damaged cones	Full seed[3]	Empty Seed	Seedbug	Seedworm	Malformed
S. Miss. loblolly	0.9	80.9	18.0	0.3	0.5	0.3
Ala. loblolly	2.6	81.5	15.1	0.2	1.0	2.2
Fla. slash	--	74.7	19.9	1.9	3.1	0.4
Miss. slash	--	83.8	10.8	2.3	3.0	0.1
Miss. longleaf	9.0	70.7	17.7	1.6	5.0	5.0

1/ Coneworm damage based on all cones collected from two ramets of each clone; other categories based on seeds (extracted from five cones from each of two ramets of each clone).

2/ Following clones were sampled- South Mississippi loblolly, 6, 12, 40, and 47; Alabama loblolly 34, 47; Florida slash, 3, 6, 18, and 19; Mississippi slash, 7, 27, 40 and 49; and Mississippi longleaf, 2, 3, 15 and 18.

3/ Percent full seed varied within the seed source as follows - South Mississippi loblolly, 74.3 to 89.4; Alabama loblolly, 80.4 to 82.9; Florida slash, 52.7 to 90.1; Mississippi slash 79.6 to 87.6; and Mississippi longleaf, 65.9 to 78.5.

Table 2. Percent damage to shortleaf pine conelets and cones (1974-75) and conelets (1975) on the Ozark geographical source at the Ouachita Orchard, Ouachita N.F., Arkansas.

Treatment	Percent damage by causal agent						
	Tip moths	Cone worms	Unknown insect	Abortion	Missing	Other	Total losses
Cygon®	4.3	4.4	5.7	0.0	63.6	2.4	80.4
Di-Syston®	0.9	2.8	2.8	0.0	47.9	1.9	56.3
Check 1/	14.9	5.6	14.9	0.0	42.3	0.0	77.8
Impact 2/, 3/ (Untreated)	45.2	5.0	7.9	20.5	11.1	3.0	92.7

1/ Sample based on 10 conelets tagged on each of 2 ramets of each of 5 clones.

2/ Sample based on 100% of female flowers tagged on 3 ramets of each of 9 clones (2,356 flowers) and examined at monthly intervals.

3/ First and second-year cone losses, Feb. 1974 - Oct. 1975.

Table 3. Percent damage to shortleaf pine cones and seed on the Ozark geographical source at Ouachita Orchard, Ouachita National Forest, Arkansas (1975).

	Total number of cones	Percent					
		Insect damaged cones	Full seed	Empty seed	Seed bug damage	Seed worm	Malformed
Check[1/]	145	26.9	45.7	50.4	3.9	0.0	0.0
Di-Syston®[1/]	196	11.2	72.5	26.5	1.0	0.0	0.0
Cygon®[1/]	61	14.8	79.8	13.4	6.8	0.0	0.0
Impact area (untreated)[2/]	172	44.7[3/]	45.6	51.5	2.5	0.0	0.1

1/ Sample based on total number of cones collected from each of 2 ramets from each of 5 clones.

2/ Sample based on total number of cones collected from each of 2 ramets from each of 9 clones.

3/ Includes cones found missing throughout the season.

Table 4. Percent[1/] of tips killed by tip moth on 6-year-old shortleaf pines treated with Cygon® and Di-Syston® at the Ouachita Orchard, Mt. Ida, Ark. (Observed Aug. and Oct. 1975).

Clone No.	Treatment					
	Cygon® 2/		Di-Syston® 3/		Control	
	Aug.	Oct.	Aug.	Oct.	Aug.	Oct.
19	10.0	67.5	12.5	47.5	37.5	82.5
27	7.5	25.0	5.0	45.0	35.0	62.5
38	0.0	55.0	0.0	30.0	20.0	70.0
43	5.0	45.0	5.0	20.0	15.0	47.5
46	5.5	32.5	12.5	42.5	40.0	72.5
Means 4/	5.5	45.0	7.0	37.0	29.5	67.0

1/ Observations based on 20 topmost tips on each of two ramets of each clone.

2/ Cygon® 2E at rate of 3.5 ml/l (4 pts/100 gal) of water applied as a drench spray with a John Bean Roto Mist sprayer. Applied April 30 to May 9, June 12 to 23, and July 31 to Aug. 11.

3/ Di-Syston® (15 percent granular) of tree diameter fertilizer spreader--subsoiled prior to application--disked after application. Applied March 15, 70 g/2.5 cm (2.5 oz/in) d.b.h.

4/ According to Duncan's new multiple range test, the following is probable at the 1 percent level: Cygon® and Di-Syston® treated trees had significantly less tips killed by tip moth.

these insects, mostly between April 1 and June 10, 1975. Many of the losses under the categories Unknown insect, Abortion, and Missing may have also been caused by tip moths, coneworms, seedworms, or other miscellaneous insects.

Although both Di-Syston® and Cygon® reduced tip moth damage to conelets, Di-Syston® was more effective in preventing overall tip, conelet, and cone losses than was Cygon® (Tables 2, 3, and 4). Flower losses on Cygon® treatments actually showed a greater loss in the Missing and Unknown Insect categories and a greater overall flower loss than did the check. Both Di-Syston® and Cygon® reduced overall second year cone insect damage by about one-half. X-rays of seed from apparently sound cones showed that percent full seed was increased by about one-third over the check on both Cygon® and Di-Syston® treatments. Identifiable seedbug damage was greatest on the Cygon® treatment; however, this may be due to the fact that some seedbugs were killed in the act of feeding and, therefore, did not completely destroy gametophyte tissue before receiving a lethal dose of insecticide.

Percent of the total seed crop that would have been produced if all second year cones and seed had survived at the Ouachita Orchard in 1975 was calculated by using the following formula:

Percent of total healthy cone crop during 1975	X	Percent of total seeds produced that were full (1975)	=	Percent of total potential seed crop produced
Di-Syston® .888	X	.725	=	64.4
Cygon® .852	X	.798	=	68.0
Check .731	X	.457	=	33.4

Data above shows that both Di-Syston® and Cygon® treatments approximately doubled the seed and conelet crops in 1975.

Mean percent tip damage in August and October to both Cygon® and Di-Syston®-treated trees was significantly less than that of the control according to a Duncan's Multiple Range Test (Table 4). There was no significant difference between means of Cygon® and Di-Syston® treatments. Both treatments showed less than 10 percent reduction of tip damage in August, but protection was considerably reduced by October.

Stuart Orchard

Detectable tip moth damage to shortleaf and loblolly conelets was light at the Stuart Orchard during 1975 (Table 5). Coneworms caused the most damage by any one identifiable agent to slash, loblolly, and longleaf conelets. Much of the undetermined damage under the Unknown Insect and Missing categories may have been caused by tip moths, coneworms, seedworms, seedbugs, or other insects. X-ray analysis of loblolly seed by the Eastern Tree Seed Center showed approximately 40.7 percent empty seed (Table 6). Although observable seedbug damage was light, much of the empty seed was undoubtedly the result of seedbug feeding. X-rays of shortleaf seed showed 28 percent identifiable seedbug damage and 60.2 percent empty seed on untreated check trees, compared with 14.5 percent and 38.7 percent, respectively, on trees treated with 8 ounces Furadan®, 10 g per inch of d.b.h. Coneworm losses to second year cones were 10.8 percent on untreated shortleaf trees, and 1.8 percent on trees treated with 12 oz of Furadan® 10 percent granules per inch d.b.h.

Pine tip moths caused 31.8 percent damage to tips on untreated loblolly pines and 65.5 percent on untreated shortleaf pines on this orchard.

SUMMARY AND CONCLUSIONS

Insect losses to pine seeds and cones are threefold: loss of the potential flower crop by shoot attack, loss to first year conelets, and loss to second year cones. Overall loss as above to the seed crop at the three Federal orchards was considerable during 1975.

Substantial insect damage to seeds and cones is expected next season and the cone crop needing protection should increase; therefore, insect control should be continued at all three orchards.

RECOMMENDATIONS

1. All orchard trees producing cones can be treated with Guthion®2L at the rate of 6 pints per 100 gallons of water with a high volume sprayer, or 30 pints per 100 gallons of water with a low volume sprayer. for coneworms and seedworms. However, this insecticide is a highly hazardous organic phosphate insecticide.3/

3/ The oral LD_{50} and dermal LD_{50} for Guthion® (technical grade) for rats are 11-13 mg/kg and 220 mg/kg, respectively.

Table 5. Damage to shortleaf, slash, loblolly and longleaf pine conelets at the Stuart Orchard, Kisatchie National Forest, Louisiana during 1975.

Species	Percent damage by causal agent						
	Tip Moths	Cone Worms	Unknown Insect	Abortion	Missing	Other	Total
Shortleaf (disk)[1/]	0.1	1.3	31.6	4.4	24.7	12.0	74.1
Shortleaf[1/]	3.1	0.0	27.0	6.1	31.3	6.7	74.2
Slash[2/]	0.0	27.1	20.8	0.0	7.8	9.4	65.9
Loblolly[2/]	0.5	11.6	16.2	0.0	4.1	11.6	46.4
Longleaf[2/]	0.0	14.7	57.0	0.2	2.6	5.8	80.3

1/ Sample based on 10% of female flowers tagged on ramet of each of 6 clones.

2/ Sample based on 10% of female flowers tagged on 2 ramets of each of 4 clones.

Table 6. Radiographic analysis of loblolly pine seed damage at Stuart Orchard - 1975 cone crop.[1/]

Geographical Source	Percent damage by causal agent				
	Full Seed	Empty Seed	Seedbug	Seedworm	Malformed
Loblolly[1/]	51.8	40.7	3.6	1.9	2.0
Shortleaf[2/]	11.8	60.2	28.8	---	---

1/ Data from Cone and Seed Analysis Report of the USFS Eastern Tree Center, Macon, Ga.

2/ X-ray data from the Southeastern Forest Experiment Station, Athens, Ga.

High volume treatments should be sprayed until runoff and low volume spray coverage should be 1/5 that needed for high volume sprays. The first application should be made within 30 days after conelet closure, with four additional applications at 30-day intervals during the season.

2. Where tip moth is a problem on smaller trees, an early application of Cygon®2E at the rate of 4 pints per 100 gallons may be used. This would be applied for each generation of the moth when larvae are migrating on external portions of shoots. An alternative to this would be using Di-Syston® granules at the rate of 2.5 oz per inch of ~~tree diameter~~ applied by fertilizer spreader and disked into the soil in February or early March[4/]. However, this material is extremely toxic to man and animal and, if used, extreme care should be taken during its handling and application. The material should be thoroughly incorporated in the soil.

3. Southwide tests during 1974 and 1975 showed Furadan® to be promising for coneworm, seedworm, seedbug, and tip moth control; however, it is not currently registered. If Furadan® becomes registered, and an application technique is developed for adequately incorporating it into the soil, consideration should be given by Federal seed orchards to using this material in lieu of Guthion®, Cygon®, or Di-Syston® treatments.

4. Rubber boots, rubber gloves, rubber rain suits, and approved respirators should be used when applying Guthion®. Rubber boots, rubber gloves, coveralls, and approved respirators should be used when applying Di-Syston®.

REFERENCES

Overgaard, et al. 1974. Seed Orchard Pest Management in the South; A Problem Analysis. USDA, For. Serv., S&PF, FPM Group. 20 p.

4/ The oral LD_{50} and dermal LD_{50} for Di-Syston® (technical grade) in rats are 2-7 and 6-15 mg/kg, respectively.